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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/528,450

05/22/2006

Sadayoshi Horii

050169

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23850 7590 01/09/2008
KRATZ, QUINTOS & HANSON, LLP
1420 K Street, N.W.
Suite 400
WASHINGTON, DC 20005

EXAMINER

DAHIMENE, MAHMOUD

ART UNIT

PAPER NUMBER

1792

MAIL DATE

DELIVERY MODE

01/09/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/528,450	Applicant(s) HORII ET AL.	
	Examiner Mahmoud Dahimene	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 October 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 21-35 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 21-35 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 22-34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 22-34 depend on claim 1, which has been canceled.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 21-29, 34, 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. (US 2003/0015764) in view of Yuan (US 2002/0163028).

Regarding claims 21, 23-29, 34 Raaijmakers discloses A dielectric film is formed by atomic layer deposition to conformally fill a narrow, deep trench for device isolation (the process recipes provided can be usefully employed in a Pulsar.TM. 2000 ALCVD.TM. reactor (paragraph 0036)). The method of the illustrated embodiments includes alternately **pulsing** vapor-phase reactants in a string of cycles, where each cycle deposits no more than about a monolayer of material, capable of completely filling high aspect ratio trenches (abstract). After the oxygen source pulse is turned off, carrier gas is allowed to flow to purge the oxidizing source gas and reaction byproducts from the chamber prior to the next reactant pulse. In other arrangements, it will be understood that the chamber can be evacuated to remove the reactant species and byproducts (paragraph 0054). Oxidizing gases such as ozone are preferred for silicon layers that terminate in organic ligands (paragraph 0052). Oxidizing gases such as water vapor are preferred for silicon layers that terminate in halide ligands (paragraph 0053). In accordance with the principles of ALD, a second pulse of the silicon source gas is then injected into the carrier gas flow. The pulse is stopped, and the silicon source gas is removed from the chamber, followed by a second oxygen source gas pulse, which is then, in turn, stopped and removed from the chamber. These pulses are

then continually alternated until the silicon oxide layer attains the desired thickness (paragraph 0056). The material of Raaijmakers is not decomposed by the temperature. At the rate of an atomic layer per cycle, the atoms can be considered to be absorbed since they have to fit on the atomic structure of the object material. "In one pulse, no more than about one monolayer of the precursor is absorbed onto the surface through chemisorption in a self-limiting reaction that stops when the surface is saturated." (paragraph 0033).

It noted that Raaijmakers is silent about an oxidizer generated by ozone in a fluid containing at least hydrogen atoms.

Yuan teaches a CVD method for CVD deposition of dielectric materials wherein "The input lines 22 and 24 direct the **ozone and water vapor** to a direct liquid injection unit (such as one available from ASTEC, Wilmington, Mass., for example) **or bubbler system 32** (such as one available from Schumacher, Santa Clara, Calif.) or other bubbler system as well known and used in the art), where **the components are mixed to form wet ozone** which is delivered to the shower head 20 via input line 6." (paragraph 0038).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Raaijmakers to bubble ozone in water because Yuan teaches such a method of delivering an oxidizer gas to a CVD chamber is conventionally known in the art of CVD dielectric deposition. One of ordinary skill in the art would have been motivated to use wet ozone in order to increase the oxidizing power of the oxidizer gas, or simply combine the desirable features of water

and ozone as oxidizers when specific properties of the resulting film are sought after, as suggested by Yuan.

As to the limitations of loading and unloading the substrate in the process chamber, it would have been obvious to one of ordinary skill in the art at the time the invention was made to load a wafer in the process chamber in order to process the wafer, and unload the wafer after the process is terminated in order to use the devices on the wafer, because if the wafer remains in the processing chamber, the devices on the wafer cannot be used to make usable functional circuits.

As to claim 22, Raaijmakers teaches "Generally, though not necessarily, heaters (not shown) are also provided to heat the substrate to within an ALD temperature window, which depends upon the particular process used." (paragraph 0038). Clearly Raaijmakers teaches temperature is an optimizing variable. Raaijmakers adds "[0044] Temperature and pressure process parameters can be modified for individual film materials and for desired film characteristics. For an ALD silicon oxide process using 3-aminopropyltrimethoxysilane as a silicon precursor, for example, it is preferable to ramp the process temperature to a range of from about 150.degree. C. to 400.degree. C., and more preferably, from about 200.degree. C. to 300.degree. C. The pressure range is preferably from about 3 Torr to 50 Torr, and, more preferably, from about 5 Torr to 20 Torr.

[0045] In an alternative embodiment of the present invention, ALD of silicon oxide can take place at **even lower temperatures**. Using remote-plasma excited oxygen and/or nitrogen sources, even room temperature processing is possible.

As will be appreciated by the skilled artisan, plasma processes generally employ lower pressures, such as in the millitorr (mTorr) range. Accordingly, any combination of precursor gases and carrier gas may be directed separately to the plasma generator which couples microwave energy from a magnetron to the flowing gases, thus generating excited species for an alternative process."

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Raaijmakers to use any temperature, including a temperature lower than a temperature causing a CVD reaction because Raaijmakers teaches the remote-plasma can be used to bring the gas to reactive for deposition allowing to keep the process temperature lower than an otherwise heat activated reaction. One of ordinary skill in the art would have been motivated to keep process temperature low in order to match the substrate coefficient of thermal expansion or avoid damaging the under-layers when they are susceptible to damage from heat.

As to claim 35, the apparatus of Raaijmakers modified by Yuan has the capability to produce the same material on the same substrate since the apparatus comprises a processing chamber for processing an object to be processed;
a heater for heating the object in the processing chamber;
an ozonizer for generating ozone
a bubbler for generating an oxidizer by bubbling ozone generated by the ozonizer, in fluid containing at least hydrogen atoms

an oxidizer supply pipe for supplying the oxidizer generated by the bubbler into the processing chamber; and
a material gas supply pipe for supplying the material gas into the processing chamber, wherein the material gas supply pipe and the oxidizer supply pipe are structured to alternately supply the material gas and the oxidizer into the processing chamber.

Claim Rejections - 35 USC § 103

4. Claims 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. (US 2003/0015764) in view of Yuan (US 2002/0163028) as applied to claim 21 above, and further in view of Buchanan et al. (US 6,984,591).

It is noted Raaijmakers is silent about hafnium, zirconium or tantalum in the dielectric.

Buchanan teaches precursors source mixtures for ALD dielectric films citing "Highly preferred precursor source mixtures comprised of at least one amino-containing precursor include: tetrakis(dimethylamino), tetrakis(diethylamino) Ti, **Zr, Hf**, Si, Ge, Sn, or Pb;" (column 14, line 55).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Raaijmakers to include a hafnium containing layer deposited by the precursor of Buchanan because Buchanan teaches it is conventional to combine hafnium and zirconium containing ALD dielectric layers with silicon or aluminum oxide layers. One of ordinary skill in the art would have been

motivated to combine a hafnium or a zirconium containing dielectric in order to obtain an effective high-k dielectric layer.

Claim Rejections - 35 USC § 103

5. Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. (US 2003/0015764) in view of Yuan (US 2002/0163028) as applied to claim 21 above, and further in view of Vaarstra (2004/0043633).

It is noted Raaijmakers is silent about tantalum in the dielectric.

Vaarstra teaches "Ta.sub.2O.sub.5 is of particular interest as layers of amorphous Ta.sub.2O.sub.5 have a dielectric constant of about 25. Ta.sub.2O.sub.5 layers can be formed using chemical vapor deposition (CVD) processes. For example, reacting vapors of Ta(OC.sub.2H.sub.5).sub.-5(pentaethoxy-tantalum) with oxygen or by reacting vapors of TaF.sub.5 with an O.sub.2/H.sub.2 plasma can form Ta.sub.2O.sub.5." (paragraph 0005)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Raaijmakers to include a tantalum containing layer deposited by the precursor of Vaarstra because Vaarstra teaches it is conventional to combine tantalum containing ALD dielectric layers. One of ordinary skill in the art would have been motivated to combine a tantalum containing dielectric in order to obtain an effective high-k dielectric layer.

Response to Arguments

6. Applicant's arguments, filed 10/16/2007, with respect to the rejection(s) of claim(s) 1-20 have been fully considered and are persuasive in view of the applicant's cancellation of those claims and adding new claims 21-35. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Raaijmakers et al. (US 2003/0015764) and Yuan (US 2002/0163028).

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mahmoud Dahimene whose telephone number is (571)

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272-2410. The examiner can normally be reached on week days from 8:00 AM. to 5:00 PM.:

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MD.

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER

